

## **REMARKS**

Claims 1-2 and 4-14 remain pending in the application. Claims 1, 2, 4, 7, 9, and 10 are currently amended. Claim 3 is cancelled. Applicants respectfully request for allowance of all pending claims based on following discussions.

### **Rejections under 35 USC §112**

Claims 1-14 are rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

**Claim 1** is amended to clarify certain indefinite terms. Specifically, on line 3 of the amended claim, “an essentially closed loop” is written into “a loop.” On line 5, “the essentially closed loop” is rewritten into “the loop.”

On line 7, “continuously passing the circulating water including the aqueous solution” is rewritten into “continuously passing the circulating water and the aqueous solution.” Such amendment aims to emphasize that the aqueous solution is a separate stream of liquid from the circulating water.

On lines 11-13, “more concentrated aqueous solutions of the separate ionic species” is rewritten into “an anolyte containing the anionic species in an increased concentration and a catholyte containing the cationic species in an increased concentration.” Such amendment aims to clarify that the solutions removed from the ion adsorption unit are concentrated anolyte and catholyte.

With regard to Examiner's inquiry about the difference between the limitation "continuously discharging from the ion adsorption unit the more concentrated solution of one ionic species" and the limitation "removing from the ion adsorption unit more concentrated aqueous solutions of the separate ionic species," Applicants respectfully submit that claim 1 is amended so that the step of "removing" is now generally directed to removing anolyte and catholyte from the adsorption unit and the steps of "continuously discharging" are now specifically directed to the manners in which the anolyte and catholyte are discharged from the ion adsorption unit.

On line 23, "continuously recycling eluate" is rewritten into "continuously passing eluate." Such amendment aims to clarify that the eluate from the reaction unit is not the same as the recycled anolyte or catholyte from the ion adsorption unit. Such amendment also aims to clarify that the eluate from the reaction unit is continuously passed to the ion adsorption unit.

On line 10, "the layer of ion adsorbing material" is rewritten into "the water permeable layer of the ion adsorbing material" so as to be more consistent with the antecedent basis "a water permeable layer of an ion adsorbing material" on line 4.

On lines 16-17, "the aqueous solution depleted" is clarified and expanded into "the aqueous solution depleted in the anionic species and cationic species as a result of the aqueous solution passing through the ion adsorption unit." Applicants respectfully submit that there is sufficient antecedent basis in the claim for the aqueous solution, and the clause "depleted in the anionic species and cationic species as a result of the aqueous solution passing through the ion adsorption unit" merely modifies the aqueous solution to suggest its different chemistries before and after it passes through the ion adsorption unit.

On lines 19-20, “continuously passing the more concentrated solution of the other ionic species” is rewritten into “continuously passing the anolyte.” Applicants respectfully submit that “the anolyte” is recited with sufficient antecedent basis.

On line 21, “the ionic species” is rewritten into “the anionic species.” Applicants respectfully submit that “the anionic species” is recited with sufficient antecedent basis.

As such, Applicants respectfully request that the rejections against claim 1 under 35 USC 112 be withdrawn.

**Claim 2** is amended so that now fluoride is defined as an anionic species and ammonium is defined as a cationic species. As such, Applicants respectfully request that the rejection against claim 2 under 35 USC 112 be withdrawn.

**Claims 3-9** are rejected for inheriting the deficiencies in claims 1 and 2. For the reasons discussed above, Applicants respectfully request that the rejections against claims 4-9 under 35 USC 112 be withdrawn. It is noted that claim 3 is cancelled.

**Claim 10** is amended by rewriting “an essentially closed loop circulation system” into “a circulation system.” As such, Applicants respectfully request that the rejection against claim 10 under 35 USC 112 be withdrawn.

**Claims 11-14** are rejected for inheriting the deficiencies in claim 10. For the reasons discussed above, Applicants respectfully request that the rejections against claims 11-14 under 35 USC 112 be withdrawn.

### Rejections under 35 USC §103

**Claim 1** is rejected under 35 USC 103(a) as being unpatentable over US Patent No. 5,584,981 to Turner et al. (hereinafter referred to as “Turner”) in view of US Patent No. 5,225,056 to Bridger et al. (hereinafter referred to as “Bridger”).

Claim 1, as amended, is directed to a method for treating an aqueous stream containing both anionic and cationic species. With reference to FIG. 1 as an illustrative embodiment of the claimed invention, the method comprises steps of: continuously circulating water through a loop (*e.g., the loop collectively indicated by components 3, 6, 1, 9, 8, and 10*) incorporating an ion adsorption unit (*e.g., numeral 3*) comprising a water permeable layer of an ion adsorbing material; feeding to the loop an aqueous solution containing the anionic species and the cationic species (*e.g., the aqueous solution admitted to unit 3 via line 2*); continuously passing the circulating water and the aqueous solution containing the anionic

species and the cationic species through the ion adsorbing material in the ion adsorption unit while applying an electric potential across a thickness of the water permeable layer of the ion adsorbing material and removing

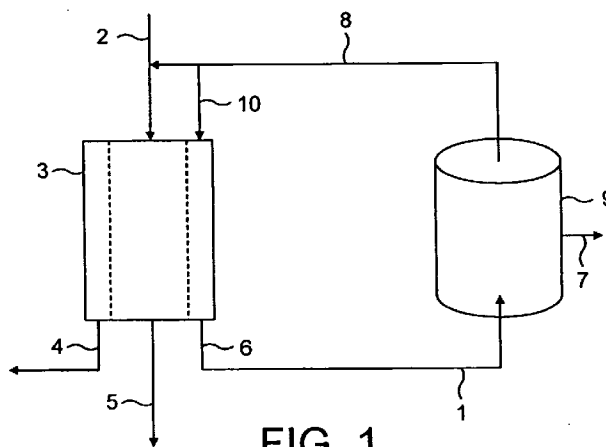


FIG. 1

from the ion adsorption unit an anolyte containing the anionic species in an increased concentration (*e.g., the anolyte discharged from unit 3 via line 6*) and a catholyte containing the cationic species in an increased concentration (*e.g., the catholyte*

*discharged from unit 3 via line 4*); continuously discharging from the ion adsorption unit the catholyte; continuously discharging from the ion adsorption unit the aqueous solution depleted in the anionic species and cationic species (*e.g., the aqueous solution discharged from unit 3 via line 5*) as a result of the aqueous solution passing through the ion adsorption unit; continuously passing the anolyte through a reaction unit (*e.g., numeral 9*) in which the anionic species reacts with a reactant added to the reaction unit to form a water-insoluble solid material; removing the water-insoluble material from the reaction unit (*e.g., the water-insoluble material is removed from unit 9 via line 7*); continuously passing eluate from the reaction unit to the ion adsorption unit; and, if necessary, adding to the loop a quantity of water corresponding to the quantity of the aqueous solution removed from the reaction unit.

***A. Neither Turner nor Bridger teaches or suggests “continuously passing the anolyte through a reaction unit in which the anionic species reacts with a reactant added to the reaction unit to form a water-insoluble solid material.”***

Turner does not teach or suggest “continuously passing the anolyte through a reaction unit in which the anionic species reacts with a reactant added to the reaction unit to form a water-insoluble solid material.” Examiner acknowledges “Turner does not explicitly teach continuously passing the more concentrated solution of the other ionic species through a reaction unit to form a water-insoluble solid material.” *See, the Office Action, page 7, lines 15-17.* It is noted that “the more concentrated solution of the other ionic species” has been amended into “the anolyte [containing the anionic species in an increased concentration” for better clarity.

Neither does Bridger teach or suggest “continuously passing the anolyte through a reaction unit in which the anionic species reacts with a reactant added to the reaction unit to form a water-insoluble solid material.” Bridger is concerned with using electrochemical ion exchange cell to separate metal ions in a solution, whose hydroxides have different solubilities in water. *See, col. 1, lines 25-29.* The solution is first passed through an electrochemical ion exchange cell in a high PH environment such that a first metal in the solution can be absorbed on the cathode of cell and a second metal in the solution can be discharged from the cell. *See, col. 1, lines 35-39.* Then, an aqueous electrolyte having a low PH value is passed through the cell such that the first metal can be desorbed from the cathode into the electrolyte. *See, col. 1, lines 47-51.* Bridger does not teach or suggest a method in which ions react with a reactant to form a water-insoluble material. Instead, Bridger’s method is about separating two water-soluble metals in an aqueous solution by manipulating the PH value of the environment in the electrochemical ion exchange cell. Regardless before or after the separation, the metals remain water-soluble.

***B. Neither Turner nor Bridger teaches or suggests “removing the water-insoluble material from the reaction unit.”***

As discussed above, Examiner acknowledges that Turner fails to teach or suggest forming a water-insoluble material. By extension, Applicants respectfully submit that Turner does not teach or suggest “removing the water-insoluble material from the reaction unit,” either.

Similarly, because Bridger does not teach or suggest forming a water-insoluble material, Applicants respectfully submit that it does not teach or suggest “removing the

water-insoluble material from the reaction unit,” either. Moreover, Applicants

respectfully submit that Bridger’s electrochemical ion exchange cell as illustrated both in FIGs. 1 and 2 is not comparable to the reaction unit of the claimed invention. In Bridger, the electrochemical ion exchange cell utilizes an electric field to move anions and cations in an aqueous solution to their respective electrodes. In the claimed invention, the reaction unit facilitates a chemical reaction between anions and reactants added to the unit to form a water-insoluble material. Bridger’s electrochemical ion exchange cell differs from the reaction unit of the claimed invention at least in their functions and achievable results.

***C. Because Turner and Bridger fail to teach each and every element of the claimed invention, claim 1 is patentable over the references under 35 USC 103(a).***

As discussed above, neither Turner nor Bridge teaches or suggests 1) “continuously passing the anolyte through a reaction unit in which the anionic species reacts with a reactant added to the reaction unit to form a water-insoluble solid material” and 2) “removing the water-insoluble material from the reaction unit.” As such, Applicants respectfully submit that claim 1 is patentable over Turner in view of Bridger under 35 USC 103(a).

**Claims 2 and 3** are rejected under 35 USC 103(a) as being unpatentable over Turner in view of Bridger and US Patent No. 3,607,694 to Heit et al. (hereinafter referred to as “Heit”).

For the reasons discussed above, claim 1 is patentable over Turner and Bridger under 35 USC 103(a). Accordingly, claim 2 that depends from claim 1 and includes all the limitations recited therein is also patentable over Turner, Bridger, and Heit under 35 USC 103(a). Claim 3 is cancelled.

**Claims 4-9** are rejected under 35 USC 103(a) as being unpatentable over Turner in view of Bridger, Heit and US Patent No. 5,403,495 to Kust et al. (hereinafter referred to as “Kust”).

For the reasons discussed above, claim 1 is patentable over Turner and Bridger under 35 USC 103(a). Accordingly, claims 4-9 that depend from claim 1 and include all the limitations recited therein are also patentable over Turner, Bridger, Heit, and Kust under 35 USC 103(a).

**Claims 10-14** are rejected under 35 USC 103(a) as being unpatentable over Turner in view of Bridger, Kust, and US Patent No. 6,274,019 to Kuwata et al. (hereinafter referred to as “Kuwata”).

Claim 10, as amended, is directed to an apparatus for use in treating an aqueous stream containing both anionic and cationic species, the apparatus comprising: a circulation system containing (i) an ion adsorption unit comprising a water permeable zone of an ion adsorbing material and means for enabling an electrical potential to be applied across a thickness of that zone and (ii) a reaction unit in which one of the anionic and cationic species is rendered substantially insoluble; a pump for continuously



circulating an aqueous solution around a loop of the circulation system; an inlet for receiving an aqueous solution containing the anionic and cationic species and eluate from the reaction unit to the ion adsorption unit; an outlet for discharging a concentrated aqueous solution of the anionic species or the cationic species from the ion adsorption unit; an outlet for discharging a depleted aqueous solution from the ion adsorption unit; an outlet for discharging an insoluble material from the reaction unit; and an inlet for receiving water into the circulation system.

None of Turner, Bridger, Kust, and Kuwata teaches or suggests “an inlet for receiving an aqueous solution containing the anionic and cationic species and eluate from the reaction unit to the ion adsorption unit.” As discussed above, it is Applicants contention that neither Turner no Bridger teaches or suggests the “reaction unit” of the claimed invention, let alone “an inlet for receiving... eluate from the reaction unit to the ion adsorption unit.” Kuwata is relied on by Examiner for its teaching of a water inlet. *See, the Office Action, page 15, lines 12-15.* Thus, Applicants respectfully submit that Kuwata does not teach or suggest “an inlet for receiving an aqueous solution containing the anionic and cationic species and eluate from the reaction unit to the ion adsorption unit,” either.

Kust is concerned with improving the filterability and settling rate of calcium fluoride in a precipitation unit. *See, col. 3, lines 9-12.* As shown in FIG. 1 of Kust, waste water and calcium-rich precipitates are admitted to treatment reactor 20 via lines 18 and 16, respectively. *See, col. 4, lines 49-53.* The calcium-rich precipitates react with the fluorine in the waste water in treatment reactor 20 to form enhanced calcium fluoride precipitates in an enlarged size. *See, col. 5, lines 2-7.* Some of the enhanced calcium

fluoride precipitates are passed from treatment reactor 20 to pre-treatment reactor 10, in

which calcium ions are attached on the surfaces of the enhanced calcium fluoride

precipitates to provide calcium-

rich precipitates in a further

enlarged size. *See, col. 4, lines*

34-53. Others are passed to

separator 30, in which finer

calcium fluoride precipitates

are returned to pre-treatment

reactor 10, and larger solid-rich

components are dewatered via line 34 through standard filtration equipment. *See, col. 5,*

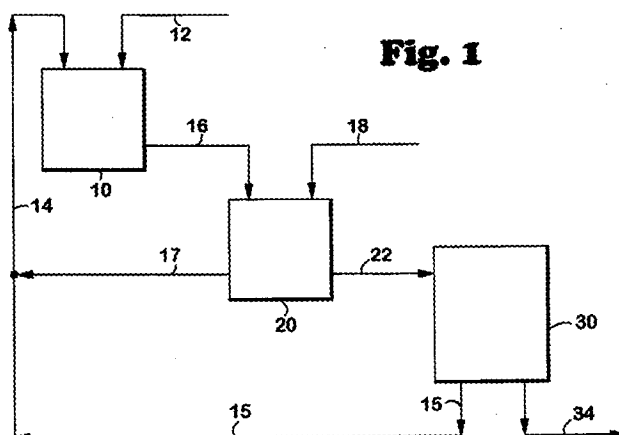
*lines 8-15.* Because the size of the precipitates discharged via line 34 is larger than the

precipitates in a conventional device, their settling rate is therefore faster than that of the

precipitates produced by the conventional device. *See, FIG. 2.*

Although Kust teaches a precipitation unit for removing solid calcium fluoride from waste water, it does not teach or suggest “an inlet for receiving an aqueous solution containing the anionic and cationic species and eluate from the reaction unit to the ion adsorption unit.” All that Kust teaches is an improved precipitation unit. It does not teach or suggest an ion adsorption unit, such as an electrochemical ion exchange cell, let alone the interconnection between the two.

Moreover, it would not have been obvious for a person skilled in the art to combine Kust and Turner by circulating the eluate from a precipitation unit through the electrochemical ion exchange cell. In Kust, the eluate streams from separator 30 are



calcium fluoride precipitates in either a finer or larger form. If those solid precipitates were circulated through an electrochemical ion exchange cell, they would have clogged the water permeable ion adsorbing material in the cell, thereby severely reducing its effectiveness and efficiency. Given that Kust's objective is to enlarge the size of the solid precipitates before they are discharged from a precipitation unit, it would not have been obvious for a person skilled in the art to circulate the eluate from the precipitation unit through an electrochemical ion exchange cell, such as the ion adsorption unit of the claimed invention.

As such, Applicants respectfully submit that claim 10 is patentable over Turner, Bridger, Kust, and Kuwata under 35 USC 103(a).

Accordingly, claims 11-14 that depend from claim 10 and include all the limitations recited therein are also patentable over Turner, Bridger, Kust, and Kuwata under 35 USC 103(a).

### **CONCLUSION**

Applicants have made an earnest attempt to place this application in an allowable form. In view of the foregoing remarks, it is respectfully submitted that the pending claims are drawn to a novel subject matter, patentably distinguishable over the prior art of record. Examiner is therefore respectfully requested to reconsider and withdraw the outstanding rejections.

Should Examiner deem that any further clarification is desirable, Examiner is invited to telephone the undersigned at the below listed telephone number.

Applicants do not believe that any additional fee is due, but as a precaution, the Commissioner is hereby authorized to charge any additional fee required by the submission to deposit account number 50-4244.

Respectfully submitted,

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